

CYTOTAXONOMICAL STUDY OF SOME MEMBERS OF *CHARA FIBROSA* COMPLEX

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ABSTRACT. — Four taxa namely, *Chara fibrosa* var. and f. *fibrosa* (n = 42), *C. fibrosa* var. *fibrosa* f. *curtissii* (n = 42), *C. fibrosa* var. *fibrosa* f. *tylacantha* (n = 42) and *C. fibrosa* var. and f. *hydropitys* (n = 14), belonging to the *C. fibrosa* complex of Wood have been worked out using a technique standardised in this laboratory. Karyogram constructed for each taxon shows a general homogeneity among them and justifies their inclusion under a single species complex as proposed by Wood, excepting *C. fibrosa* var. and f. *hydropitys*, the karyotype of which appears to be quite distinct from other taxa of the *C. fibrosa* complex studied in this paper and may be considered as a distinct species. Total form percent (TF%) value calculated ranges from 33.33 to 37.56, confirming their position in between primitive ecorticated and advanced corticated triplostichous taxa. The chromosome number of *C. fibrosa* var. *fibrosa* f. *tylacantha* (n = 42) is determined for the first time and that of *C. fibrosa* var. *fibrosa* f. *curtissii* (n = 42) represent a new polyploid number not reported earlier by any worker.

RÉSUMÉ. — Quatre taxons, *Chara fibrosa* var. et f. *fibrosa* (n = 42), *C. fibrosa* var. *fibrosa* f. *curtissii* (n = 42), *C. fibrosa* var. *fibrosa* f. *tylacantha* (n = 42) et *C. fibrosa* var. et f. *hydropitys* (n = 14), appartenant au complexe spécifique *C. fibrosa* de Wood ont été étudiés au point de vue cytologique. Les détails de leurs caryotypes ont été précisés en utilisant une technique mise au point dans ce laboratoire. Les caryogrammes construits pour chaque taxon offrent une certaine homogénéité entre eux et justifient que les taxons soient inclus dans un seul complexe spécifique comme Wood l'a proposé, à l'exception de *C. fibrosa* var. et f. *hydropitys*, dont le caryotype semble être très différent des autres taxons du complexe *C. fibrosa* étudiés dans ce travail, et qui peut être considéré comme une espèce distincte. La valeur TF% (total form percent) calculée s'élève de 33,33 à 37,56, confirmant leur position entre les taxons primitifs écortiqués et les taxons triplostiques cortiqués évolués. Le nombre chromosomique de *C. fibrosa* var. *fibrosa* f. *tylacantha* (n = 42) est déterminé pour la première fois; celui de *C. fibrosa* var. *fibrosa* f. *curtissii* (n = 42) représente un nouveau nombre polyploïde non signalé antérieurement par un chercheur. (traduit par la rédaction).

KEY WORDS : karyotype, *Chara*, cytotaxonomy.

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INTRODUCTION

Chara fibrosa of Wood (1962) represents a species complex comprising of a large number of species and varieties which were considered by classical authors like Sundaralingam (1959), Pal *et al.* (1962) as distinct species. *C. benthamii*, *C. flaccida* and *C. gymnopytis* were considered as distinct species, while Wood (1962) and Wood & Imahori (1965) relegated all these species under a single species *C. fibrosa*. The characters which were used to distinguish between the three species mentioned above, are stipulodes and branchlet number and colouration of oospores. However, intermediate characters are often exhibited by the members of *C. fibrosa* complex and thus a clearcut demarcation between these three species is often very difficult to make. The present investigation was undertaken to analyse the karyotype of different members of *C. fibrosa* complex growing in West Bengal in order to gain some insight into the validity of such an amalgamation in the light of karyotype data gathered by us. This investigation is important to ascertain the position of different members of this species complex in the evolutionary hierarchy.

MATERIAL AND METHOD

Chromosome preparations for studying karyotypic details were prepared from actively growing cells of antheridial filaments. The detailed methodology was essentially the same as standardised by Ray & Chatterjee (1986). Chromosome morphology was designated according to Levan *et al.* (1964) on the basis of centrometric index value. Total form percent (TF%) was calculated according to Huziwara (1962) and Kapoor & Löve (1970) and the grouping of chromosomes according to length as was done by Khan & Sarma (1967).

TF% = Ratio in percentage of the total sum of short arm lengths to the total length of chromosomes

$$\text{i. e. TF\%} = \frac{\text{Total sum of short arm lengths}}{\text{Total length of chromosomes}} \times 100$$

OBSERVATIONS AND DISCUSSION

The observations are summarized in the Table I.

Four representatives of the sub-section *Agardhia* have been investigated namely, *C. fibrosa* var. and *f. fibrosa*, *C. fibrosa* var. *fibrosa* f. *curtissii*, *C. fibrosa* var. *fibrosa* f. *tylacantha* and *C. fibrosa* var. and *f. hydrophytis*, showing chromosome number of $n = 42, 42, 42$ and 14 respectively (Pl. 1, Figs 1-4). Sarma & Khan (1965) determined $n = 14$ for *C. flaccida* from Uttar Pradesh, while Ramjee & Bhatnagar (1978) reported $n = 28$ in plants from Moradabad. Mukhopadhyay & Chatterjee (1980) also reported $n = 14$ and $n = 42$ for two popula-

TABLE I

Name of the taxon	Chromosome number (n)	Range of chromosome length in μm	TF %	Karyotype formula
<i>Chara fibrosa</i> Ag. ex Bruz. var. <i>fibrosa</i> <i>f. fibrosa</i>	42	1.38-4.14	36.07	L(O)+M(Sm ₈ +m ₀ +St ₃) +S(Sm ₁₈ +m ₈ +St ₅)
<i>C. fibrosa</i> var. <i>fibrosa</i> <i>f. curtissii</i> (T.F.A. ex Roxb.) R.D.W.	42	1.38-3.68	37.56	L(O)+M(Sm ₃ +m ₀ +St ₁) +S(Sm ₂₇ +m ₈ +St ₃)
<i>C. fibrosa</i> var. <i>fibrosa</i> <i>f. tylacantha</i> (Nordst.) R.D.W.	42	1.38-5.06	37.56	L(Sm ₁ +m ₀ +St ₀) +M(Sm ₄ +m ₁ +St ₁) +S(Sm ₁₈ +m ₉ +St ₈)
<i>C. fibrosa</i> var. <i>hydropitys</i> (Reich.) R.D.W. <i>f. hydropitys</i>	14	1.38-3.45	33.33	L(O)+M(Sm ₀ +m ₀ +St ₁) +S(Sm ₅ +m ₄ +St ₄)

L : Long; M : Medium; S : Short; Sm : Submedian; m : Median; St : Subterminal.

tions of *C. flaccida*, occurring in West Bengal, India. Recently Labh & Verma (1986) has also reported chromosome numbers of some members of *C. fibrosa* complex namely, *C. fibrosa* var. *fibrosa f. fibrosa* (n = 42, 63); *C. fibrosa* var. *fibrosa f. curtissii* (n = 14); *C. fibrosa* var. and *f. hydropitys* (n = 14); *C. fibrosa* var. *hydropitys f. schneckii* (n = 28). It is thus clear that different members of *C. fibrosa* complex show chromosome numbers of different ploidy level ranging from n = 14 to 63. Chromosome number determined for *C. fibrosa* var. *fibrosa f. tylacantha* (n = 42) from West Bengal, India, is a new record. The taxon itself has not been located so far in any region of India outside West Bengal. The n = 42 chromosome number determined for *C. fibrosa* var. *fibrosa f. curtissii* is also a new polyploid number recorded in this investigation, since previous count for this taxon was n = 14 by Sarma (1968) and Sarma & Ramjee (1971) from Uttar Pradesh, India. The chromosome number n = 14 obtained in *C. fibrosa* var. and *f. hydropitys* is confirmatory with the previously published counts (Sarma & Khan, 1965; Sinha & Noor, 1967; Sinha & Verma, B.N. 1970; Ramjee & Sarma, 1971).

As regards the detailed karyotype (Pl. 2, Figs. 1a, 2a, 3a, 4a) there appears to be general homogeneity in most members of *C. fibrosa* studied excepting *C. fibrosa* var. and *f. hydropitys*, the karyotype of which is quite distinct from other members of *C. fibrosa* complex in having one chromosome with secondary constriction in the subterminal category. Khan & Sarma (1967) expressed the

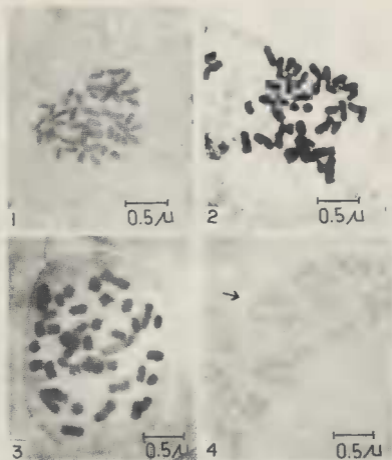


Planche 1. — 1. Metaphase of *Chara fibrosa* var. *fibrosa* f. *fibrosa* showing $n = 42$ chromosomes. 2. Metaphase of *Chara fibrosa* var. *fibrosa* f. *curtissii* showing $n = 42$ chromosomes. 3. Metaphase of *Chara fibrosa* var. *fibrosa* f. *tylacantha* showing $n = 42$ chromosomes. 4. Metaphase of *Chara fibrosa* var. *hydroptitys* f. *hydroptitys* showing $n = 14$ chromosomes.

view that placement of *C. hydroptitys* as a variety under *C. fibrosa* as suggested by Wood (1962) is justified since they obtained a close similarity in the karyotype of *C. flaccida* with this taxon. From the evidences so far obtained from karyotype analysis in the present study and due to the fact that this taxon shows a constant chromosome number $n = 14$ in all specimens studied so far from different geographical areas, it is better to consider this taxon as a distinct species — *C. hydroptitys* as was done by majority of classical taxonomists.

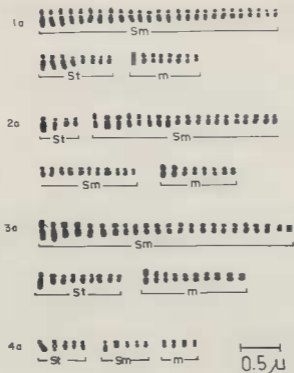


Planche 2. — Idiograms of 1a : *Chara fibrosa* var. *fibrosa* f. *fibrosa*, 2a : *Chara fibrosa* var. *fibrosa* f. *curtissii*, 3a : *Chara fibrosa* var. *fibrosa* f. *tylacantha*, 4a : *Chara fibrosa* var. *hydropitys* f. *hydropitys*.

The karyotype of other three taxa studied are more or less of the same type, showing a slight gradation in chromosome size and differing from one another only with regard to the constituent number of submedian, subterminal and median chromosomes. Hence, inclusion of all these three taxa under the species complex *C. fibrosa* with different formal status as proposed by Wood (1965) is fully justified.

The geographical distribution of the species of the sub-section *Agardhia* is highly interesting. According to Wood (1962), and Wood & Imahori (1965), species of *C. fibrosa* are principally confined to the African, Asian and Australian arc from which most of their species were reported. Excepting the record of *C. fibrosa* var. and f. *fibrosa* (*C. gymnopitys*) with $n = 28$ chromosomes from North Carolina, U.S.A. (Hotchkiss, unpublished), *C. fibrosa* var. *fibrosa* f. *curtissii* from Florida, U.S.A., most of the other taxa of *C. fibrosa* complex occur in Southeast Asian Zone. The cytology of *C. gymnopitys* in India has to

far been carried out from three different geographical regions, Northern Zone (principally Benaras and Rohilkhand subdivision of Uttar Pradesh), Southern Zone (Karnataka) and Eastern Zone (West Bengal and Bihar). Chennaveeraiah & Bharati (1974) recorded the chromosome number of the following intra-specific taxa of *C. gymnopitys*: *C. gymnopitys* var. *typica* (A. Br.) Zanev.; *C. gymnopitys* var. *duriuscula* (A. Br.) Zanev.; *C. gymnopitys* var. *trachypitys* (A. Br.) Zanev.; *C. gymnopitys* var. *acanthopitys*. These specimens were collected from different localities of Mysore State.

Outside India, a high polyploid chromosome number of $n = 42$ has been reported from Fiji by Hotchkiss (1965). *C. fibrosa* var. and f. *fibrosa* (*C. benthamii*) showed $n = 14$, both in the Northern and Southern parts of India. Whereas in West Bengal $n = 14$ and $n = 42$ are in record. In *C. flaccida* on the other hand, $n = 14$ chromosomes are common to both Uttar Pradesh (Benaras) and Maharashtra (Sarma & Khan, 1965). In West Bengal, in addition to $n = 14$, $n = 42$ has also been recorded (Mukhopadhyay & Chatterjee, 1980) which has been confirmed in the present investigation. A chromosome number of $n = 28$ has been found from Moradabad, Uttar Pradesh, India by Ramjee & Bhatnagar (1978). *C. flaccida*, therefore, shows polyploid races in different geographical regions of India. Several other forms of *C. fibrosa* var. *fibrosa* like f. *curtissii*, f. *longicorollata* and f. *tylacantha* have been studied cytologically showing chromosome numbers $n = 14$ (Ramjee & Sarma, 1971), $n = 28$ (Chatterjee, 1979) and $n = 42$ (present report) respectively. It is significant that f. *longicorollata* and f. *tylacantha* were previously recorded only from Japan and Australia respectively, has now been recorded from India, also. In the present investigation, besides $n = 14$, $n = 42$ has also been recorded for f. *curtissii*, thereby showing again that this taxon is a polyploid one.

Of *C. fibrosa* var. *hydropitys* the chromosome number so far recorded from India is $n = 14$ (Ramjee & Sarma 1971; Ramjee & Bhatnagar, 1978 - all from U.P.) as well as from West Bengal (present report). This is the only taxa of *C. fibrosa* complex so far worked out in India from different regions which did not show any other chromosome number than $n = 14$. Though Noor & Mukherjee (1975) have claimed to have recorded $n = 8$ in some antheridial cells of a single globule of the taxon, their findings require further confirmation. One more taxon belonging to *C. fibrosa* complex namely *C. fibrosa* var. *fibrosa* f. *erythrogyna* has been studied cytologically by Ramjee & Bhatnagar (1978) showing n chromosome number of $n = 14$ of specimens from Moradabad, Uttar Pradesh.

High values of TF% over 40.0 may be taken as indicative of a more or less symmetrical karyotype, whereas lower values (i. e. around 30.0) is a feature of asymmetrical karyotype (Kapoor & Löve, 1970). The symmetry of the karyotype has frequently been suggested as an indication of the degree of specialization of a species (Levitsky, 1931; Stebbins, 1950), so that an asymmetrical karyotype would be characteristics of an advanced species as compared with symmetrical karyotype. Members of the *Chara fibrosa* complex having TF% value in one range 33.33-37.56 confirms an intermediate position between

primitive ecorticated taxa like *C. braunii* and advanced corticated triplostichous taxa like *C. zeylanica* (unpublished).

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